Weekend Onset of Acute Myocardial Infarction Does Not Have a Negative Impact on Outcome in Japan

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Background   Studies from North America indicate that patients admitted during the weekend with acute myocardial infarction (AMI) have a worse outcome than weekday-admitted patients, probably reflecting a lower rate of invasive procedures. However, it is unclear whether the same is true in Japan, which has a different healthcare system.
Methods and Results   Using the Japanese Acute Coronary Syndrome Study (JACSS) database, this study included 4,805 consecutive patients who were admitted within 48 h of onset of AMI (3,526 [73.4%] patients with weekday onset [Monday through Friday] and 1,279 [26.6%] with weekend onset [Saturday and Sunday]). There were no significant differences between the 2 groups in patient background and clinical features. The proportions of patients who underwent emergency catheterization (88.4% vs 88.0%) and reperfusion therapy (81.5% vs 81.4%) were also similar. There were no differences between the 2 groups in the in-hospital, 30-day, and 1-year mortality rates. Even after various adjustments, there was no difference in the risk of death associated with weekend versus weekday onset of AMI.
Conclusion   There were no obvious differences in outcome for Japanese AMI patients in the weekday- or weekend-onset group, suggesting the quality of the Japanese healthcare system is similar for the entire week. (*Circ J* 2007; **71:** 1841–1844)

Key Words: Myocardial infarction; Mortality; Weekend

Recent studies from North America report outcome differences between patients admitted to acute care hospitals on a weekday vs the weekend; that is, the mortality rate of patients admitted on weekends tended to be higher.[1,2] The difference was interpreted to be related to low staffing levels and availability of emergency

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procedures on the weekends compared with weekdays[3,4] However, it is not clear whether this is also applicable to Japanese patients and hospitals.

Generally, Japanese acute care hospitals operate under similar schedules as in other developed countries and routine care is usually scheduled and provided on weekdays. Ideally, the level of care on weekends should be similar to that on weekdays, but this is often limited to emergency cases and those patients with special needs or conditions. On weekends, staff senior physicians are available on call if required for consultation. Therefore, a worse clinical outcome for Japanese patients admitted during the weekend compared with weekday admission, similar to the North American situation, cannot be ruled out.

However, Japan has a unique healthcare system compared with other countries. Japanese citizens are covered by public healthcare insurance and the direct personal cost of medical care is low.[5] The healthcare system also allows a person to call an ambulance in case of emergency for free transport to the hospital. Furthermore, highly advanced invasive procedures, such as stent implantation for patients with an acute myocardial infarction (AMI), are widely available across Japan at low cost to the patient.[6]

The aim of this study was to assess the clinical outcomes for weekday and weekend admission to hospitals for patients with AMI in Japanese acute care hospitals.

Table 1   Characteristics of Patients Stratified by Day of Onset of Acute Myocardial Infarction (n=4,805)

	Weekday onset (n=3,526)	Weekend onset (n=1,279)	p value
Patient background			
Age (years)*	68.1±12.4	67.9±12.0	0.722
Male	70.9%	70.4%	0.733
Hypertension	57.4%	57.4%	0.986
Diabetes mellitus	32.6%	31.3%	0.414
Hyperlipidemia	32.8%	33.7%	0.563
Body mass index (kg/m²)*	23.6±3.4	23.5±3.1	0.180
Current smoker	45.8%	46.9%	0.542
Serum creatinine (mg/dl)*	1.06±1.06	1.06±1.05	0.925
Previous myocardial infarction	12.2%	14.5%	0.044
Pre-infarction angina pectoris	38.6%	37.2%	0.389
ST elevation myocardial infarction	87.1%	89.1%	0.071
Killip class ≥II	18.9%	20.8%	0.133
Q wave infarction	71.8%	72.4%	0.679
Management			
Time from onset to hospital admission (h)*	6.59±8.59	6.18±8.52	0.149
Emergency coronary angiography	88.4%	88.0%	0.750
Reperfusion therapy	81.5%	81.4%	0.942
Percutaneous coronary intervention	72.6%	72.8%	0.913
Stent implantation	61.2%	58.5%	0.091
Outcomes			
In-hospital mortality	8.7%	9.4%	0.463
30-day mortality	6.6%	6.7%	0.991
1-year mortality	8.0%	7.7%	0.795

*Mean±standard deviation.

Methods

Patients and Data Collection

This study formed part of the Japanese Acute Coronary Syndrome Study (JACSS), the details of which are published elsewhere[7–10] In brief, a collaborative multicenter observational study was conducted at 35 institutions across Japan, mostly academic and teaching hospitals located in urban areas. The study cohort comprised consecutive patients who presented at each institution within 48h of the onset of myocardial infarction (MI) and who were admitted between January 1, 2000 and December 31, 2003.

AMI was diagnosed based on elevated myocardial enzymes, with either typical chest pain persisting longer than 30min or ECG changes, including ischemic ST depression or elevation, and Q wave indicative of significant pathology. Increased enzyme levels were defined as peak creatine kinase levels greater than twice the upper normal limit. With regard to the clinical management after arrival at hospital, the allocation of procedures such as emergency coronary angiography and reperfusion therapy was determined by the attending physician. The definition of emergency catheterization was diagnostic and/or for therapeutic purposes; cardiac catheterization was performed in patients with acute coronary syndrome within 24h of onset.

Data, including demographic information, past medical history, baseline clinical characteristics, initial physical and laboratory findings, invasive procedures conducted for evaluation and treatment, and patient outcome were collected at each institution by physician investigators who were unaware of the study hypothesis. The results were sent to the Department of Cardiology at Kumamoto University Hospital for processing. Direct patient identifiers were not collected so as to protect patient confidentiality. Standardized definitions were used for all patient-related variables, clinical diagnoses, and hospital outcomes. The study protocol was approved by the Human Ethics Review Committees of Kumamoto University and of each participating institution. Informed patient consent was not required for registry entry in this study.

Statistical Analysis

Data are expressed as mean±standard deviation for continuous variables and percentages for categorical variables. Univariate analyses were chi-square test and Fisher's exact test for categorical variables, and t-test for continuous variables as appropriate. The statistical significance for overall difference of survival probabilities between 2 groups was tested by log-rank test. To adjust for potential confounders, we used the Cox proportional-hazard model to compare the risk of death associated with weekend onset versus weekday onset. First, we adjusted for patient background and clinical characteristics (age, sex, comorbidities [hypertension, diabetes, previous MI], history of previous angina, Killip class, ST elevation on ECG, serum creatinine level, and body mass index [BMI]). Age was divided into four 10-year bins, and creatinine level and BMI were adjusted for the 4 age-groups divided by quartile points, respectively. Second, we also designed a model to adjust for emergency angiography and reperfusion therapy. P<0.05 was considered statistically significant. All analyses were performed using SAS software (version 9.1, SAS, Cary, NC, USA).

Results

The study subjects comprised 4,805 patients, of whom those with weekday (Monday through Friday) onset of AMI numbered 3,526 (73.4%) and those with weekend (Saturday and Sunday) onset were 1,279 (26.6%). There were no significant differences in patient background, such as age (68.1 vs 67.9 years, p=0.722) and male sex ratio (70.9% vs 70.4%, p=0.733), between weekday- and weekend-onset patients, except for previous MI, which was higher

among weekend-onset patients (12.2% vs 14.5%, p=0.044). Moreover, the clinical features at hospital arrival were not significantly different between the 2 groups, such as the proportion of patients with ST elevation (87.1% vs 89.1%, p=0.071) and Killip class ≥II (18.9% vs 20.8%, p=0.133) (Table 1).

The time from onset of AMI to hospital admission did not differ between the 2 groups (6.59 vs 6.18h, p=0.149) and emergency catheterization was conducted in similar proportions of patients (88.4% vs 88.0%, p=0.750). With regard to interventional procedures, there were no differences in the proportions of patients who underwent reperfusion therapy (81.5% vs 81.4%, p=0.942) or percutaneous coronary intervention (PCI) (72.6% vs 72.8%, p=0.913). However, analysis of the interventional therapy showed a higher frequency of stenting for weekday-onset patients, although the difference was not significant (61.2% vs 58.5%, p=0.091).

There were no significant differences in outcome, including the in-hospital (8.7% vs 9.4%, p=0.463), 30-day (6.6% vs 6.7%, p=0.991) and 1-year (8.0% vs 7.7%, p=0.795) mortality rates. The overall survival probabilities of the 2 groups were similar (log-rank test, p=0.324). The adjusted hazard ratio (HR) for mortality was not statistically significant, adjusted for both patient background and clinical features (HR: 1.090, 95% confidence interval [CI]: 0.814–1.458), as well as management (HR: 1.066, 95%CI: 0.797–1.427).

Discussion

We found no obvious difference between patients with weekend- or weekday-onset AMI admitted to Japanese hospitals, including clinical background, management and outcome.

A number of studies have reported that AMI is not a random event but occurs in definite patterns related to the day of the week and season of the year[11,12] In the present study, when we divided patients into 2 groups; those with weekday-onset and those with weekend-onset AMI, the ratio of the 2 groups was approximately 5:2, but there were no significant differences in clinical features, although they were within measured variables as shown in Table 1. With regard to the clinical course during hospitalization, it was relatively easy to compare management patterns and outcomes between these 2 groups.

Several studies from the United States and Canada have analyzed the relationship between day of week admission to hospital and outcome[1–3] and most[1,2] have shown worse outcomes for patients admitted on weekends compared with those admitted on weekdays to acute care hospitals; the scope of these studies was not limited to AMI but rather covered diseases in general[1,2] In this regard, Kostis et al recently analyzed a large data set and reported a higher mortality rate for patients with MI who were admitted on weekends[4] and they concluded that the worse prognosis was in part because of the lower rate of invasive procedures conducted during the acute phase of the condition.

In contrast to those studies, our results showed that the onset of AMI followed by admission to Japanese hospitals either on the weekday or weekend did not influence the clinical management and outcome. For example, there were no differences between the 2 groups in the mean time from onset to admission (ie, transport from the home to hospital), or in the rates of either emergency catheterization

or PCI. Although our study showed a higher rate of stenting for patients admitted on weekdays, the difference with that of patients admitted during the weekend was not statistically significant. It is possible that the latter finding was because of the availability for skilled staff physicians on the weekends.

Compared with other previous large studies, our findings support the good accessibility and availability of the Japanese healthcare system, even on weekends. These factors contributed directly to the good outcome for patients with weekend-onset AMI compared with those admitted on weekdays. It should be noted that our results are based on relatively recent data and probably reflect the new advances in clinical management, including new and more effective drugs, advances in invasive procedures and better evidence-based medicine, that minimized the difference in overall outcome. From a healthcare provider's point of view, our findings can be interpreted that Japanese healthcare professionals, including not only physicians but also co-medical staff, provide similar quality of care on weekends as on weekdays. This should be stressed as an example of the success of the high-quality Japanese healthcare system, in addition to the low cost of healthcare, among the developed countries, which is often mentioned.[5] In other words, acute health care is available on the weekend at levels similar to those on weekdays in Japanese hospitals. However, it should be noted that this success is owed largely to the personal dedication of the healthcare professionals.

On the other hand, it has been reported that PCI is highly utilized in Japan and a high rate of success is achieved, even though it is assessed angiographically[13] Considering these results together, it is unfair to label the high rate of invasive procedures in Japanese hospitals as "overuse" of PCI[14] Nevertheless, the efficacy of the Japanese healthcare system, admittedly, might be not perfect, and there is still room for improvement of the quality of care without sacrificing patient outcomes. Therefore, the development of a scientific tool to assess the appropriateness of PCI[15] in addition to the application of that tool to each case in this Japanese population, is necessary.

Study Limitations

First, although this study included more than 4,000 patients, it is much smaller than previous North American studies[4,16] so it is possible that the small sample size did not have satisfactory power to detect small differences in outcome between the 2 groups. In addition, limited numbers of variables were available in the present study for detailed analysis, and there might have been unmeasured factors that needed to be adjusted for. For example, public holidays were not included in our analysis, and the timing of the invasive procedures was uncertain. These concerns might have underestimated the differences in outcome between weekdays and weekends. Second, the institutions that participated in this study were from urban areas, and our results might not represent the entire Japanese public hospital system and patients. Based on these limitations, it might be difficult to generalize our results throughout Japan. However, based on the functioning of the Japanese healthcare system, such as insurance and good accessibility, we believe our results would not be significantly different from those for the entire country. Third, in our study, our time concern variable was "day of onset". However, the former studies used "admission day" because most of their data

were administrative in nature. Thus, caution should be exercised when comparing the 2 studies. This is important because our results reflect and include the quality of care for the patient before hospital arrival, such as accessibility of transport and availability of beds for admission, whereas the other studies reflected quality of clinical care after arrival at hospital.

In conclusion, the results of the present study showed similar outcomes for patients who developed acute MI on a weekday or on the weekend. The results express the similar quality of care in Japanese hospitals, regardless of the day of the week. Further studies are necessary for a detailed analysis including not only AMI but also other conditions, in order to improve the quality of care and patients' outcomes in Japanese acute care hospitals.

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Appendix 1

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